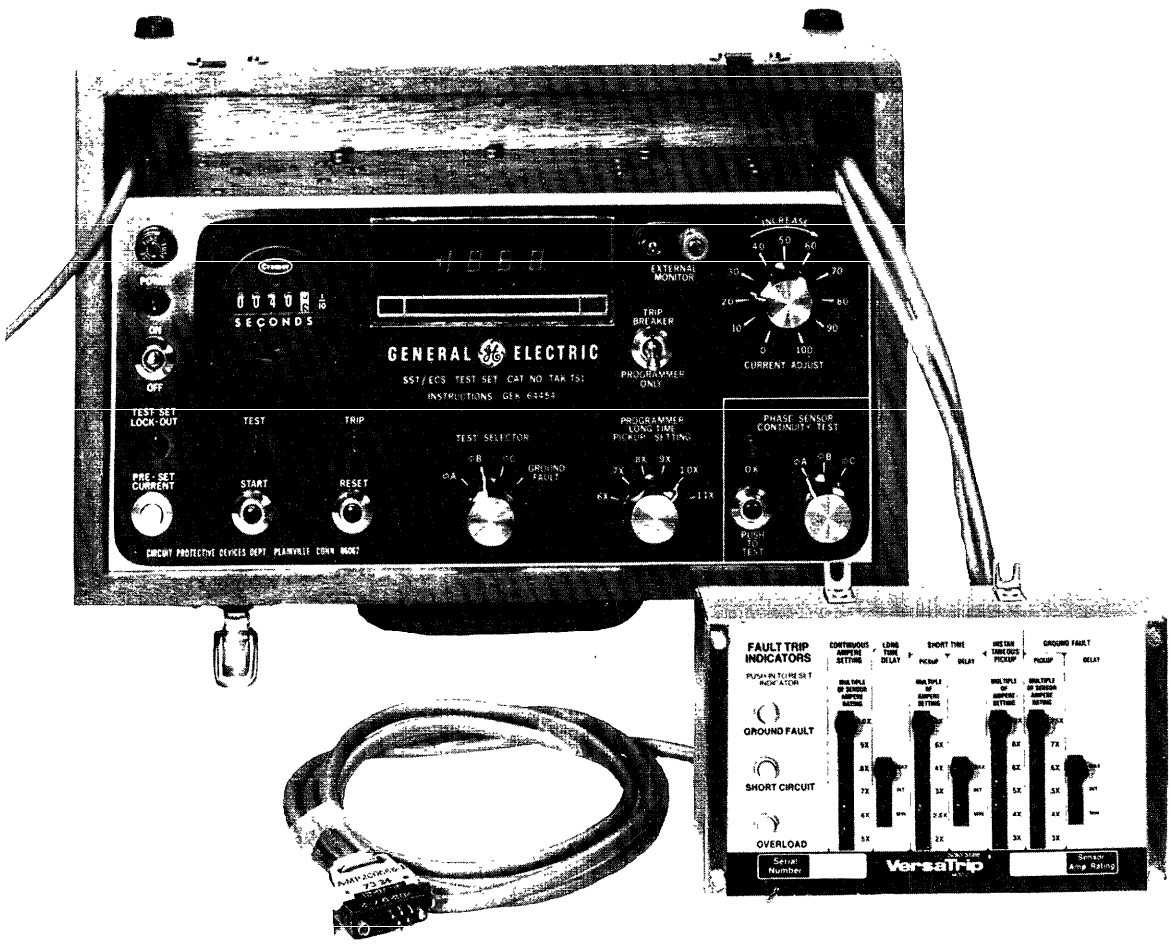
POWER-BREAK®
General
Circuit Protective Devices Department— Plainville, Connecticut 06062

Testing VersaTrip® Mod. 2 with Test Set Cat. No. TAK-TS1



instructions

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

CONTENTS

INTRODUCTION

Test Set TAK-TS1 is a portable instrument designed for field testing the performance of Types SST and ECS solid-state overcurrent trip devices.

The purpose of these instructions is to extend the usefulness of the TAK-TS1 Test Set so that it may also be used to test VersaTrip Model 2 solid-state trip devices. It may not be used to test earlier VersaTrip model types.

Following are a list of components which comprise the complete trip device system:

1. Solid-state Programmer Unit
2. Phase Current Sensors
3. Flux Shift Magnetic Trip Device
4. Fourth-wire Neutral Sensor for units containing a Ground Fault trip element for use on three-phase, four-wire load circuits.

All components, except the Neutral Sensor, are mounted integral to the circuit breaker. When used, the Neutral Sensor is separately mounted in the bus or cable compartment of the switchgear. In drawout construction, it is automatically connected to the trip device on the breaker via a drawout secondary disconnect block.

The TAK-TS1 Test Set is used to perform the various trip device tests in two basic modes:

"A" – Solid State Programmer Unit Only
"B" – Complete Trip Device System

WARNING: *THESE TESTS CAN BE CONDUCTED ONLY ON A DEENERGIZED BREAKER – ONE WHICH IS COMPLETELY DISCONNECTED FROM ITS PRIMARY AND CONTROL POWER SOURCES.*

All tests are conducted with the programmer plug disconnected from the breaker. It may be necessary to remove the programmer from the breaker to gain access to its test plug.

SOLID-STATE PROGRAMMER UNIT ONLY – MODE "A"

Test Scope

1. Verify the time-current characteristics and pickup calibration of the various trip elements. Designations for the trip elements are abbreviated as follows:

LT – Long Time
ST – Short Time
INST – Instantaneous
GF – Ground Fault

2. Verify operation of the fault-trip indicators on Programmer units so equipped.

COMPLETE TRIP DEVICE SYSTEM – MODE "B"

Test Scope

1. Perform all programmer tests previously described, plus the provision to activate the Flux Shift Magnetic Trip Device to verify its operation by physically tripping the breaker.

2. Check continuity of the Phase Sensors.

SPECIFICATIONS

Input: 105-125 Vac 50/60 Hz
Power Consumption: 150 watts maximum
Weight: 20 pounds
Dimensions: 15 in. L x 9 in. H x 9 3/4 in. D

APPLICABLE TIME-CURRENT CURVES

VersaTrip MOD 2 LT, ST + INST – GES-6184, -6186, -6187, and -6188

VersaTrip MOD 2 Ground Fault – GES-6185, -6189, -6190, and -6191

OPERATING CONTROLS

The Test Set indicators and operating controls are identified on the front panel arrangement shown in Fig. 1 and described on pages 4 and 5.

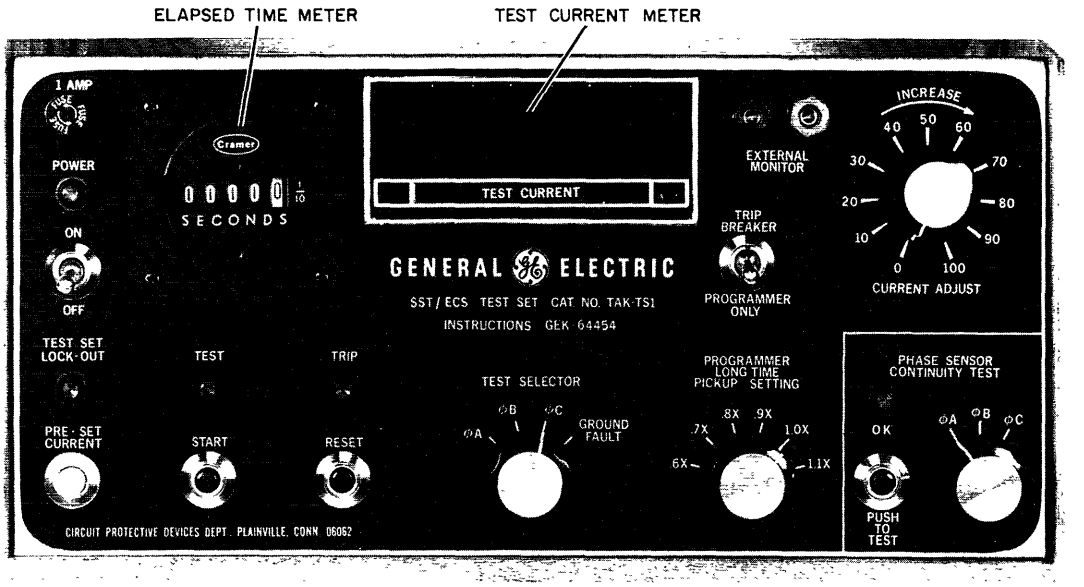


Fig. 1. Front panel of Test Set TAK-TS1

ON-OFF SWITCH

Applies 115 Vac input power to the test set. A red companion LED indicator, located directly above, illuminates when the switch is in the ON position. Protection is provided by a one ampere fuse, located above the indicator light.

TRIP BREAKER – PROGRAMMER ONLY SWITCH

Provides a choice of two test modes:

Programmer Only Position – Mode "A"

The programmer's trip signal output is confined to the test set circuitry and cannot trip the breaker.

Trip Breaker Position – Mode "B"

The programmer's trip signal output is directed to the circuit breaker's magnetic trip device to physically trip the breaker. This mode establishes the integrity of the magnetic trip device and the programmer's capability to actuate it.

TEST SELECTOR

Positioned according to the type of test desired – Phase Current A, B, C, or GROUND FAULT.

PROGRAMMER LONG-TIME PICKUP SETTING SELECTOR

Establishes a test-current magnitude consistent with, and specifically for, each continuous ampere setpoint on the programmer. For all phase current testing (LT, ST and INST elements), the position of this control must match the continuous ampere setting on the programmer.

CURRENT ADJUST KNOB

A variable transformer for establishing the desired level of test current to be applied to the programmer.

PRE-SET CURRENT BUTTON

Enables the operator to pre-establish (via the CURRENT ADJUST control) the desired test current prior to initiating a test. For this control to function, the programmer unit must be connected to the test set.

START BUTTON

Initiates the test run by applying current to the programmer. The current persists until the unit trips or the RESET button is actuated.

TEST INDICATOR

This LED lights whenever the PRE-SET CURRENT or START controls are activated.

TRIP INDICATOR

An LED which, when lit, indicates that an acceptable trip signal has been delivered by the programmer. Conversely, a trip not accompanied by the light signifies that the trip signal amplitude is too low. Upon completion of a test, the TRIP indicator stays lit until the RESET button is depressed.

RESET BUTTON

Resets the Test Set logic so that a new test sequence can be initiated. It also stops a test in progress.

PHASE SENSOR CONTINUITY TEST

This section of the panel contains controls for checking electrical continuity of each phase sensor circuit. The selector determines the phase to be tested. Proper continuity exists when the OK LED indicator lights up when the PUSH TO TEST button is depressed. No light signifies that a high resistance or open circuit exists in the CT or its wiring harness (see Note 3, page 14).

TEST-CURRENT METER

Provides digital readout of the normalized test-current level being applied to the Programmer Unit. It is never necessary to calculate a test-current value.

ELAPSED TIME METER

A mechanical counter which records the programmer's tripping time, in seconds and tenths. It must be manually reset after completion of each test.

NOTE: *When operating the Test Set from a 50-Hz supply, readings of the Elapsed Time Meter must be multiplied by a 1.2 factor.*

TEST SET LOCK-OUT INDICATOR

To prevent possible damage to the Programmer Unit when subjected to abnormally prolonged or continuous testing at high-current levels, a lock-out circuit is provided. This circuit monitors the current-time input to the programmer such that when a predetermined limit is exceeded, the Test Set becomes inoperative for a period of approximately 70 seconds. It then automatically resets to its normal operating state. A lock-out condition exists whenever the TEST SET LOCK-OUT indicator is lit.

EXTERNAL MONITOR JACKS, TEST SET ACCURACY

The test-current values displayed on the Test Current Meter are accurate to within ± 3 percent of the meter reading. These limits are contingent upon a clean sine wave input voltage to the Test Set. Wave distortion can cause additional error.

Should greater accuracy be desired, provision is made for connecting external instruments via the EXTERNAL MONITOR jacks on the front panel. These jacks are connected across an isolated, precision 0.2-ohm resistor in series with the test current circuit. Output at these jacks is shown in Table 1.

The EXTERNAL MONITOR jacks may also be employed, in conjunction with a storage oscilloscope, for more accurate measurement of trip times. For trip times in the range of less than one second, the Test Set's time meter can provide only a single digit approximation (nearest 0.1 second).

TABLE I

EXTERNAL MONITOR OUTPUT

TEST SET CONTROL POSITIONS		AC MILLIVOLTS PER TEST CURRENT UNIT (± 1%)
TEST SELECTOR	PROGRAMMER LONG TIME PICKUP SETTING	
ϕA, ϕB or ϕC	0.6X	60
	0.7X	70
	0.8X	80
	0.9X	90
	1.0X	100
	1.1X	110
GROUND FAULT	(Not Applicable)	100

EXAMPLE: The external monitor output, with a programmer long-time pickup setting of 0.7X and a Test-Current Meter reading of 6.00 = 70 x 6.00 = 420 mv ± 1 percent.

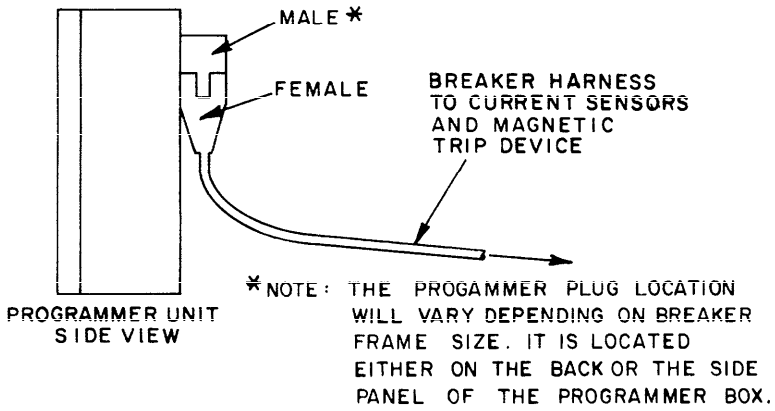


Fig. 2. Normal in-service breaker connection

CONNECTING THE TEST SET

SAFETY PRECAUTIONS

WARNING: *BEFORE CONNECTING THE TEST SET TO THE BREAKER TRIP DEVICE SYSTEM, ENSURE THAT THE CIRCUIT BREAKER IS COMPLETELY DISCONNECTED FROM ITS POWER SOURCE. ON DRAWOUT EQUIPMENT, RACK THE BREAKER TO ITS DISCONNECTED POSITION. VERIFY THAT THE BREAKER IS TRIPPED.*

CAUTION: *NEVER DISENGAGE THE HARNESS CONNECTOR FROM THE PROGRAMMER UNIT ON A BREAKER THAT IS ENERGIZED AND CARRYING LOAD CURRENT. THIS WILL OPEN-CIRCUIT THE CURRENT SENSORS, ALLOWING DANGEROUS AND DAMAGING VOLTAGES TO DEVELOP. SEE FIG. 2.*

CONNECTIONS

NOTE: *Before proceeding with the following connection work, ensure that the Test Set power supply cord is not connected.*

"PROGRAMMER ONLY" TEST – MODE "A" (SEE FIG. 3)

1. Remove breaker cover and Programmer Unit.

2. Disconnect the breaker harness from the Programmer Unit.

3. Plug the Test Set female connector lead to the receptacle on the rear of the programmer.

4. The Test Set male connector lead need not be connected to the breaker harness for "Programmer Only" testing. However, the Fig. 4 connection should be used if "Complete System" tests are to be run also.

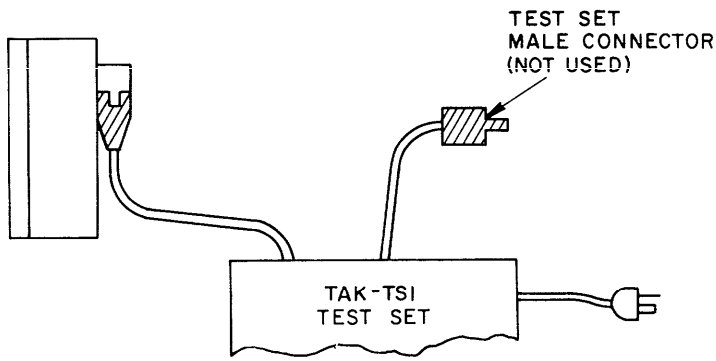
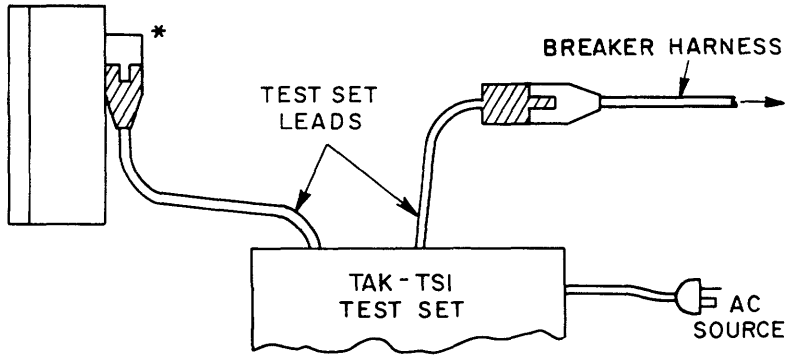


Fig. 3. Connection for "Programmer Only" test



*NOTE: THE PROGAMMER PLUG LOCATION WILL VARY DEPENDING ON BREAKER FRAME SIZE. IT IS LOCATED EITHER ON THE BACK OR THE SIDE PANEL OF THE PROGRAMMER BOX.

Fig. 4. Connection for Complete System test

"COMPLETE SYSTEM" TEST – MODE "B" (SEE FIG. 4)

1. Remove breaker cover and Programmer Unit.

2. Disconnect the breaker harness from the Programmer Unit and reconnect its female connector to the male connector lead from the Test Set.

3. Plug the Test Set female connector lead into the receptacle on the programmer.

4. Breakers with VersaTrip MOD 2 are provided with programmer position interlocks. These must be bypassed and the breaker cover replaced to also test the Flux Shift Device.

PRELIMINARY TEST PROCEDURE

The following steps should be conducted before starting functional tests.

1. Position the Test Set controls as follows:

   CURRENT ADJUST: Rotate to zero

   TEST SELECTOR: ϕA

   TRIP BREAKER – PROGRAMMER ONLY: As desired.

   PROGRAMMER LONG-TIME PICKUP SETTING: Position this knob identical to the programmer's continuous ampere setting.

2. Record the "In Service" settings of the programmer so that its set points can be restored upon completion of testing.

3. Connect the Test Set power cord to the 105-125 Vac power source.

4. Turn power ON.

5. Push the START button. The Elapsed Time Meter will start to run and the TEST indicator should light and remain lit.

6. Push the RESET button. The Elapsed Time Meter will stop and the TEST indicator light will go out.

7. Mechanically reset the Elapsed Time Meter. Functional testing, described individually for each trip element in subsequent pages, may now begin.

LONG-TIME PICKUP TEST

PURPOSE

Verify that pickup occurs within tolerance. For any given pickup setting, this is achieved in two steps:

1. Test for NO PICKUP at a current value slightly below the published lower tolerance limit. See Note 1.

2. Test for PICKUP at a current value slightly above the published upper tolerance limit. See Note 2.

PROCEDURE

NO PICKUP

1. Programmer settings:

   LONG-TIME DELAY – set on MIN band.

   The INT or MAX bands may be used if desired.

2. Position Test Set controls:

   PROGRAMMER LONG-TIME PICKUP SETTING – Must match the programmer's continuous ampere setting.

   TEST SELECTOR – ϕA, B or C

   TEST CURRENT – Preset the NO TRIP test current shown in Table 2.

3. Reset timer and RESET button.

4. Push START – Allow test to run until time delay of Table 2 has expired. Unit should NOT trip. For 50-Hz operation, multiply timer readings by 1.2.

PICKUP

1. Position Test Set controls – Same as NO PICKUP, Step 2, except:

   Preset CURRENT LEVEL to the trip current shown in Table 2.

2. Reset timer and RESET button.

3. Push START. Allow test to run until unit trips. The time meter reading should conform to Table 2 limits. For 50-Hz operation, multiply timer readings by 1.2.

   If unit does not trip within the specified time, repeat the test carefully monitoring and readjusting the test current as necessary. Transient dips in the supply voltage could lower the test signal current below its pickup value, causing the programmer's timing circuit to reset.

Repeat PICKUP and NO PICKUP tests on the other phases.

TABLE 2

LONG TIME PICKUP
VERSATRIP MODEL 2 PROGRAMMERS

MODE	TEST CURRENT SENSOR AMP RATING*		TEST LIMITS TIME IN SECONDS		
	1600A OR LESS	2000A OR MORE	MIN BAND	INT BAND	MAX BAND
NO TRIP	0.50	1.00	250	500	1000
TRIP	0.65	1.30	<200	<400	<800

*The sensor amp rating is shown on the face of the programmer being tested.

NOTE: *1. Lower test limits are extended below the published pickup tolerance to allow for Test Set accuracy.*

NOTE: *2. Upper test limits exceed the published pickup tolerance to allow for Test Set accuracy plus nominal dips in Test Set supply voltage. During testing, the test current should be monitored and adjusted, if necessary.*

If test results do not conform, see page 15.

LONG-TIME DELAY TEST

PURPOSE

Verify that the LT characteristic conforms to its upper and lower band limits. This test requires measurement of delay times at three different values of test current.

PROCEDURE

1. Position Test Set controls:

   PROGRAMMER LONG-TIME PICKUP SETTING – Must match the programmer's continuous ampere setting.

   TEST SELECTOR – ϕA, B, or C

   TEST CURRENT – From Table 3, select three test-current values. Preset the first value.

   NOTE: *These values must be below the short time and instantaneous pickup settings on the programmer, otherwise a premature trip signal will be received from those functions.*

2. Reset timer and RESET button.

3. Push START. Allow test to run until trip occurs. TIME meter reading should conform to Table 3 limits. For 50-Hz operation, multiply timer readings by 1.2.

4. Repeat the above test at the other two test values. This step verifies the linearity of the T-C characteristic.

5. Repeat the test on the other phases at one test value.

Repeat the above test series on the other delay bands.

TABLE 3

LONG TIME DELAY
VERSATRIP MODEL 2 PROGRAMMERS

X VALUE	TEST CURRENT SENSOR AMP RATING* 1600A OR LESS	TEST CURRENT SENSOR AMP RATING* 2000A OR MORE	TEST LIMITS† TIME IN SECONDS MIN BAND	TEST LIMITS† TIME IN SECONDS INT BAND	TEST LIMITS† TIME IN SECONDS MAX BAND
1.5X	0.75	1.50	60.2-101.8	120.0-203.7	240.8-407.4
2.0X	1.00	2.00	33.8-57.3	67.7-114.6	135.4-229.2
3.0X	1.50	3.00	15.0-25.5	30.1-50.9	60.2-101.8
4.0X	2.00	4.00	8.4-14.3	16.9-28.6	33.8-57.3
5.0X	2.50	5.00	5.4-9.2	10.8-18.3	21.6-36.7
6.0X	3.00	6.00	3.7-6.4	7.5-12.7	15.0-25.5
7.0X	3.50	7.00	2.7-4.7	5.5-9.3	11.0-18.7
8.0X	4.00	8.00	2.1-3.6	4.2-7.2	8.4-14.3

*The sensor amp rating is shown on the face of the programmer being tested.
†Reflecting the ± 3 percent Test Set accuracy, all test limits are extended beyond the published band limits of the time-current curves. During testing, the test current should be monitored and readjusted if necessary.

If test results do not conform, see page 15.

SHORT-TIME PICKUP TEST

PURPOSE

Verify that pickup occurs within tolerance. This requires two tests at any desired pickup setting – one for pickup at the upper tolerance limit, the second for no pickup at the lower tolerance limit.

PROCEDURE

PICKUP

1. Programmer settings:

   ST DELAY BAND – As desired.

   INST PICKUP – Must be set higher than the ST pickup setting, otherwise the unit will trip first on INST mode.

2. Position Test Set controls:

   PROGRAMMER LONG TIME PICKUP SETTING – Must match the programmer's continuous ampere setting.

   TEST SELECTOR – ϕA, B, or C

   TEST CURRENT – Preset an upper test-current limit from Table 4.

3. Reset timer and RESET button.

4. Push START. The unit must trip in less than one second, as indicated by the timer. For 50-Hz operation, multiply timer readings by 1.2.

ACTUAL PICKUP VALUE (if desired) –

Starting at the lower tolerance limit (Table 4), test incremental increases in test current until a trip occurs in less than one second, as indicated by the timer. Push the PRE-SET CURRENT button, read the actual pickup value.

NO PICKUP

1. Programmer settings – Same as PICKUP, Step 1.

2. Position Test Set controls – Same as PICKUP, Step 2 except:

   TEST CURRENT – Preset the lower test-current limit from Table 4.

3. Push START. The unit must not trip in less than one second. However, a trip may occur after one second due to a signal from the LT element. For 50-Hz operation, multiply timer readings by 1.2.

Repeat PICKUP and NO PICKUP tests for at least one setting on each of the other phases.

TABLE 4

SHORT-TIME PICKUP
VERSATRIP MODEL 2 PROGRAMMERS

PROGRAMMER PICKUP SETTING	TEST CURRENT							
	SENSOR AMPERE RATING* 1600A OR LESS				SENSOR AMPERE RATING* 2000A OR MORE			
	60 HZ		50 HZ		60 HZ		50 HZ	
	LOWER LIMIT (NO TRIP)	UPPER LIMIT (TRIP)	LOWER LIMIT (NO TRIP)	UPPER LIMIT (TRIP)	LOWER LIMIT (NO TRIP)	UPPER LIMIT (TRIP)	LOWER LIMIT (NO TRIP)	UPPER LIMIT (TRIP)
1.5	0.65	0.85	0.63	0.82	1.30	1.70	1.27	1.65
2	0.87	1.13	0.84	1.10	1.75	2.27	1.69	2.20
2.5	1.09	1.42	1.05	1.37	2.18	2.83	2.11	2.75
3	1.30	1.70	1.27	1.65	2.61	3.40	2.54	3.30
4	1.74	2.27	1.69	2.20	3.49	4.54	3.39	4.40
5	2.18	2.83	2.11	2.75	4.36	5.67	4.24	5.50
6	2.61	3.40	2.54	3.30	5.23	6.80	5.08	6.59
7	3.05	3.97	2.96	3.85	6.11	7.93	5.92	7.69
8	3.49	4.53	3.38	4.40	6.98	9.07	6.78	8.79

*The sensor ampere rating is shown on the face of the programmer being tested.

If test results do not conform, see page 15.

SHORT-TIME DELAY TEST

PURPOSE

Provide an approximate indication that time delay occurs within the time band selected. Due to the small time magnitudes involved (0.5 seconds or less), the timer's right digit provides only a rough approximation of the actual trip time. If a more accurate reading is desired, the EXTERNAL MONITOR jacks may be employed as described previously in OPERATING CONTROLS.

PROCEDURE

1. Programmer settings:

   INST PICKUP – Use maximum setting

   SHORT-TIME PICKUP – Use minimum setting

2. Position Test Set controls:

   PROGRAMMER LONG-TIME PICKUP SETTING – Must match the programmer's continuous ampere setting.

   TEST SELECTOR – ϕA, B, or C

   TEST CURRENT – Preset a test-current value two steps higher than the programmer's ST pickup setting (e.g., preset 5.0 for a 3X pickup setting). This avoids measurement at the knee of the time-current curve, where the time delay may be longer than the band limits given in Table 5.

3. Reset timer and RESET button.

4. Push START. Observe trip time.

Repeat the above test on the other time bands, then check at least one band on each of the other phases.

TABLE 5

SHORT TIME DELAY

BAND	PUBLISHED BAND LIMITS TIME IN SECONDS	
	LOWER	UPPER
MIN	0.095	0.17
INT	0.21	0.30
MAX	0.35	0.48

If test results do not conform, see page 15.

INSTANTANEOUS PICKUP TEST

PURPOSE

Verify that pickup occurs within tolerance. This requires two tests at a given pickup setting – one for pickup at the upper tolerance limit, the second for no pickup at the lower tolerance limit.

PROCEDURE

PICKUP

1. Position Test Set controls:

   PROGRAMMER LONG-TIME PICKUP SETTING – Must match the programmer's continuous ampere setting.

   TEST SELECTOR – ϕA, B, or C

   TEST CURRENT – Preset an upper test-current limit from Table 6.

2. Reset timer and RESET button.

3. Push START. The unit must trip immediately as indicated by little or no discernible timer movement.

ACTUAL PICKUP VALUE (if desired) –

Starting at the lower tolerance limit (Table 6), test incremental increases in test current until an INST trip occurs (no discernible timer movement). Push the PRESET CURRENT button, read the actual pickup value.

NO PICKUP

1. Position Test Set controls – Same as PICKUP, Step 1, except:

   TEST CURRENT – Preset the lower test-current limit from Table 6.

2. Push START. The unit must not trip instantaneously (as in PICKUP, Step 3) – the INST element is not activated at these lower limit values. However, the unit is subject to and will respond to a time-delayed trip signal from the LT element. Also, if so equipped, it responds to any ST element whose pickup is set below the INST setting. In either event, the delayed trip produces definite movement of the timer, a positive indication that the unit did not trip via the INST mode.

Repeat PICKUP and NO PICKUP tests for at least one setting on each of the other phases.

TABLE 6

INSTANTANEOUS PICKUP
VERSATRIP MODEL 2 PROGRAMMERS

PROGRAMMER PICKUP SETTING	TEST CURRENT							
	SENSOR AMPERE RATING* 1600A OR LESS				SENSOR AMPERE RATING* 2000A OR MORE			
	60 HZ		50 HZ		60 HZ		50 HZ	
	LOWER LIMIT (NO TRIP)	UPPER LIMIT (TRIP)	LOWER LIMIT (NO TRIP)	UPPER LIMIT (TRIP)	LOWER LIMIT (NO TRIP)	UPPER LIMIT (TRIP)	LOWER LIMIT (NO TRIP)	UPPER LIMIT (TRIP)
2X	0.87	1.13	0.84	1.10	1.74	2.27	1.69	2.20
2.5X	1.09	1.42	1.05	1.37	2.18	2.83	2.11	2.75
3X	1.30	1.70	1.27	1.65	2.60	3.40	2.54	3.30
4X	1.74	2.27	1.69	2.20	3.49	4.54	3.39	4.40
5X	2.18	2.83	2.11	2.75	4.36	5.67	4.24	5.50
6X	2.61	3.40	2.54	3.30	5.23	6.80	5.08	6.59
7X	3.05	3.97	2.96	3.85	6.11	7.93	5.92	7.69
8X	3.49	4.53	3.38	4.40	6.98	9.07	6.78	8.79
10X	4.36	5.67	4.23	5.50	8.73	11.33	8.47	10.99

*The sensor ampere rating is shown on the face of the programmer being tested.

If test results do not conform, see page 15.

GROUND FAULT PICKUP TEST

PURPOSE

Verify that pickup occurs within tolerance. Two tests are required at a given pickup setting — one for pickup at the upper tolerance limit, the second for no pickup at the lower tolerance limit.

PROCEDURE

PICKUP

1. Position Test Set controls:

   TEST SELECTOR — Ground Fault

   TEST CURRENT — Preset an upper test-current limit from Table 7.

2. Reset timer and RESET button.

3. Push START. The unit must trip, timer will indicate less than one second. For 50-Hz operation, multiply timer readings by 1.2.

ACTUAL PICKUP VALUE (if desired) —

Starting at the lower limit (Table 7), test incremental increases in Test Current until a trip occurs in less than one second, as indicated by the timer. Push the PRESET CURRENT button, read the actual pickup value.

NO PICKUP

1. Position Test Set Controls — Same as PICKUP, Step 1 except:

   TEST CURRENT — Preset the lower test-current limit from Table 7.

2. Reset timer and RESET button.

3. Push START. The unit should not trip, timer will read greater than one second delay. Discontinue the test after one second. If the test is allowed to run longer than 30 seconds, a trip signal can be received from the LT element for some programmer setting combinations. For 50-Hz operation, multiply timer readings by 1.2.

TABLE 7

GROUND FAULT PICKUP
VERSATRIP MODEL 2 PROGRAMMERS

PROGRAMMER PICKUP SETTING	TEST CURRENT							
	SENSOR AMPERE RATING* 1600A OR LESS				SENSOR AMPERE RATING* 2000A OR MORE			
	60 HZ		50 HZ		60 HZ		50 HZ	
	LOWER LIMIT (NO TRIP)	UPPER LIMIT (TRIP)	LOWER LIMIT (NO TRIP)	UPPER LIMIT (TRIP)	LOWER LIMIT (NO TRIP)	UPPER LIMIT (TRIP)	LOWER LIMIT (NO TRIP)	UPPER LIMIT (TRIP)
0.18X	0.078	0.102	0.076	0.099	0.157	0.204	0.152	0.198
0.2X	0.087	0.113	0.085	0.110	0.174	0.227	0.169	0.220
0.22X	0.096	0.125	0.093	0.121	0.192	0.249	0.186	0.242
0.25X	0.109	0.142	0.106	0.137	0.218	0.283	0.212	0.275
0.3X	0.130	0.170	0.127	0.165	0.260	0.340	0.254	0.330
0.35X	0.152	0.198	0.148	0.192	0.305	0.397	0.296	0.385
0.4X	0.174	0.227	0.169	0.220	0.348	0.453	0.339	0.440
0.45X	0.196	0.255	0.191	0.247	0.392	0.510	0.381	0.495
0.48X	0.209	0.272	0.203	0.264	0.419	0.544	0.407	0.528
0.50X	0.218	0.283	0.212	0.275	0.436	0.567	0.424	0.550
0.60X	0.261	0.340	0.254	0.330	0.523	0.680	0.508	0.659
0.70X	0.305	0.397	0.296	0.385	0.611	0.793	0.593	0.769
0.75X	0.327	0.425	0.318	0.412	0.654	0.850	0.635	0.824

*The sensor ampere rating is shown on the face of the programmer being tested.

If results do not conform, see page 15.

GROUND FAULT TIME-DELAY TEST

PURPOSE

Provide an approximate indication that time delay occurs within the time band selected. Due to the small time magnitudes involved (0.5 seconds or less), the timer's right digit provides only a rough approximation of the actual trip time. If a more accurate reading is desired, the EXTERNAL MONITOR jacks may be employed as described previously in OPERATING CONTROLS.

PROCEDURE

1. Position Test Set controls:

   TEST SELECTOR – Ground Fault

   TEST CURRENT – Preset a test-current value of 1.90. This ensures that the test current is well above the knee of the curve for all GROUND FAULT pickup settings.

2. Reset timer and RESET button.

3. Push START. Observe trip time.

Repeat test on the other time bands.

TABLE 8

GROUND FAULT TIME DELAY

BAND	PUBLISHED BAND LIMITS TIME IN SECONDS	
	LOWER	UPPER
MIN	0.065	0.12
INT	0.165	0.24
MAX	0.30	0.40

If test results do not conform, see page 15.

PHASE SENSOR CONTINUITY TEST

PURPOSE

Check continuity of the breaker-mounted phase sensors.

NOTE 1. *The Test Set does not measure accuracy of the phase sensors. This can be established only by testing the complete trip device as a system, in conjunction with the breaker, using a commercially available high-current – low-voltage test set.*

NOTE 2. *The Test Set is not for use in testing the equipment-mounted neutral sensor employed with trip devices equipped with a ground fault trip element for three-phase, four-wire applications. This neutral sensor is excluded from the scope of the circuit breaker/trip device test procedures, and instead should be treated as an integral part of the maintenance and testing activity associated with the switchgear equipment.*

NOTE 3. *The PHASE SENSOR CONTINUITY TEST was designed to sense the existence of dc resistance values abnormally higher than the values normally found in the broad family of SST/ECS current sensors. Sensors used with VersaTrip programmers, however, can have higher dc resistance values and may represent a marginal operating area for the continuity tester for sensors used in circuit breakers with the following catalog numbers: TPSS5616, THSS5616, THKS4612, THKSS4612, TPSS9640, and THSS9640. If an OK light is not obtained when testing VersaTrip programmers in these circuit breakers, it does not necessarily mean that the sensors are defective. In this case, it is recommended that the continuity be checked with an ohmmeter between terminals A-C, D-F, and H-K at the male connector plug from the circuit breaker harness.*

PROCEDURE

1. Ensure all power is removed from the circuit breaker and that the male connector from the Test Set is connected to the female connector of the circuit breaker harness.

2. Select the phase to be tested.

3. Push the PUSH-TO-TEST button. The OK light must light while the PUSH-TO-TEST button is depressed. Absence of the OK light indicates a high resistance or open circuit in the CT or wiring harness.

If test results do not conform, see page 15.

FAULT TRIP INDICATORS

As an optional accessory, programmers may be equipped with pop-out type fault-trip indicators located along the top of the face plate.

In operation, these plungers pop out each time their respective trip element delivers a trip signal. If a programmer trips on LT overload, only that indicator is activated. For short circuits, a single indicator serves both the ST and INST elements and is activated by either. The GF indicator responds only to a ground fault trip.

When testing programmers so equipped, the trip indicators are functioning properly if they are activated each time their respective trip element trips.

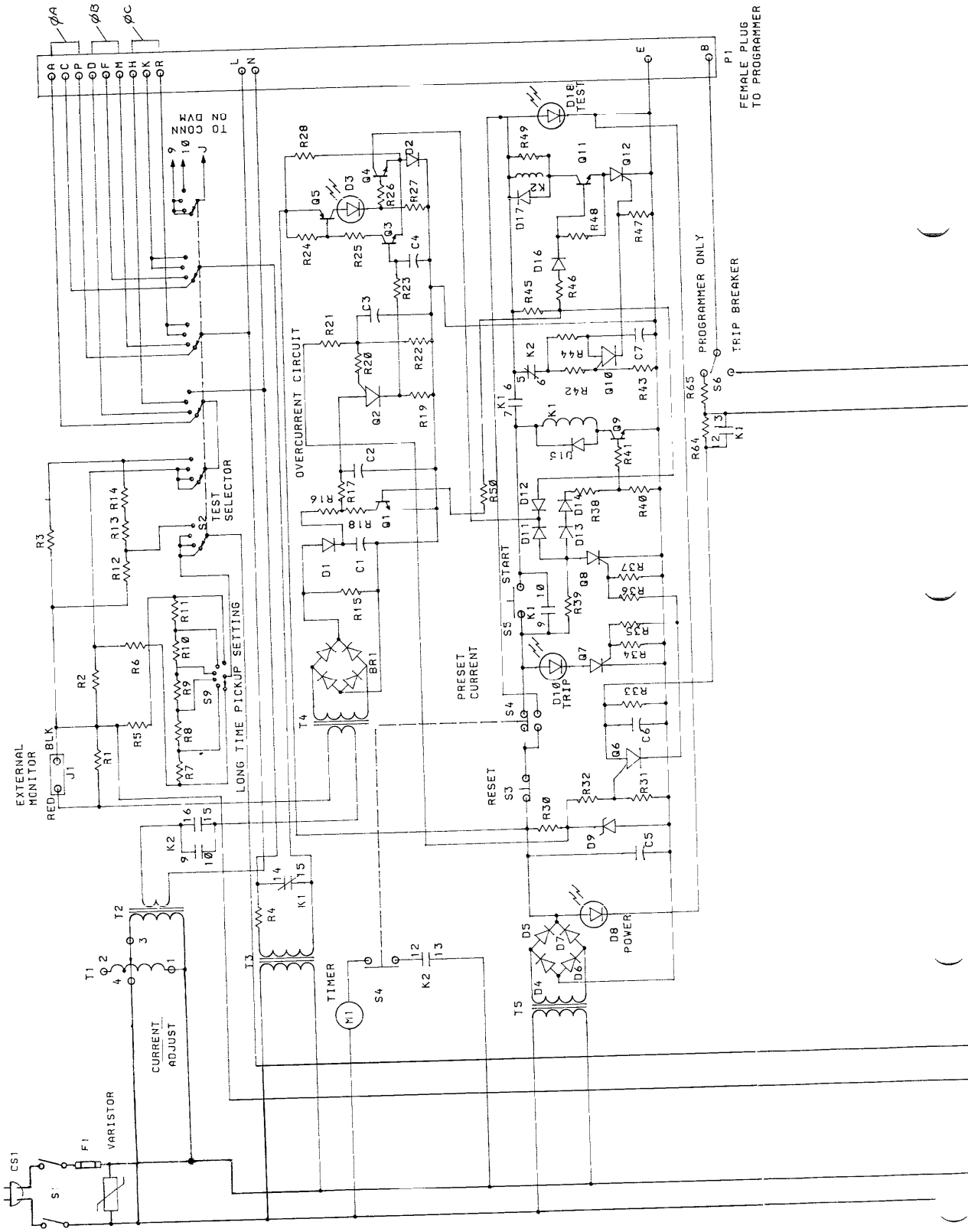
IF TEST RESULTS DO NOT CONFORM

- Review the instructions to see that the proper test procedure is being followed.
- Check all settings on the Programmer Unit.
- Is the TEST SELECTOR switch in the GROUND FAULT position for ground fault testing? In the ϕA, ϕB or ϕC position for all other tests?
- Does the PROGRAMMER LONG-TIME PICKUP SETTING control on the Test Set match the programmer's continuous ampere setting?
- Is the TRIP BREAKER – PROGRAMMER ONLY switch in the proper mode?
- Are all cable connectors fully engaged?
- If the ST element trips too soon or at too low a level, the INST pickup setting is probably too low. The INST pickup must be set at a higher X value than the ST element. Pickup band tolerances must also be considered.
- Timer makes noise but does not operate. Push RESET button. Manually reset timer.
- When using 50-Hz power, the timer reading must be multiplied by 1.2.
- See Section OPERATING CONTROLS regarding test set accuracy.
- Use the EXTERNAL MONITOR jacks as described in OPERATING CONTROLS to check the current level that is being applied to the Programmer Unit. These jacks may be used also to monitor trip time.
- If the PHASE SENSOR CONTINUITY TEST OK light does not light, refer to Note 3 of the instructions for that test.
- If, after repeating the test(s), results do not conform, do not reconnect the circuit breaker until the defective component is replaced.

COMPLETION OF TESTS

After the trip device testing has been completed, diligent procedures must be exercised preparatory to restoring the circuit breaker to service:

- Ensure that the breaker is fully disconnected from any power source.
- Disengage the Test Set connectors from the programmer and the female circuit-breaker harness connector.
- Reconnect the female harness connector to the Programmer Unit. Failure to do this voids the breaker's automatic trip system.
- Reset all fault-trip indicators on the programmer.
- If the programmer's adjustment knobs were moved to different settings during testing, restore them to their original, "as received" settings.


ØA
ØB
ØC
A C P D F M H K R
L N
E B
P1
FEMALE PLUG TO PROGRAMMER
TO CONN ON DVM
9 10 J
R28
D2
D3
Q4
Q5
R26
R27
Q3
R24
R25
C4
R23
C3
R21
R20
R22
Q2
R19
OVERCURRENT CIRCUIT
C2
R17
R18
Q1
D1
C1
R15
BR1
T4
R3
R12
R13
R14
S2
TEST SELECTOR
R2
R6
R11
R10
R9
R8
R7
S9
LONG TIME PICKUP SETTING
R5
R1
EXTERNAL MONITOR
BLK
J1
RED
K2
16
15
14
K1
T2
T1
T3
R4
TIMER
M1
S4
12
13
CURRENT ADJUST
VARISTOR
F1
CS1
S1
D18 TEST
R49
Q11
Q12
D17
R48
R47
D16
R46
R45
R44
R42
Q10
C7
R43
K2
K1
Q9
R41
R65
S6
PROGRAMMER ONLY
TRIP BREAKER
R64
D12
D11
D13
D14
R38
R40
R50
START
S5
R39
Q8
R37
R36
R35
R34
Q7
D10 TRIP
PRESET CURRENT
S4
R33
C6
Q6
R32
R31
RESET
S3
R30
D9
C5
D5
D7
D6
D4
T5
D8 POWER

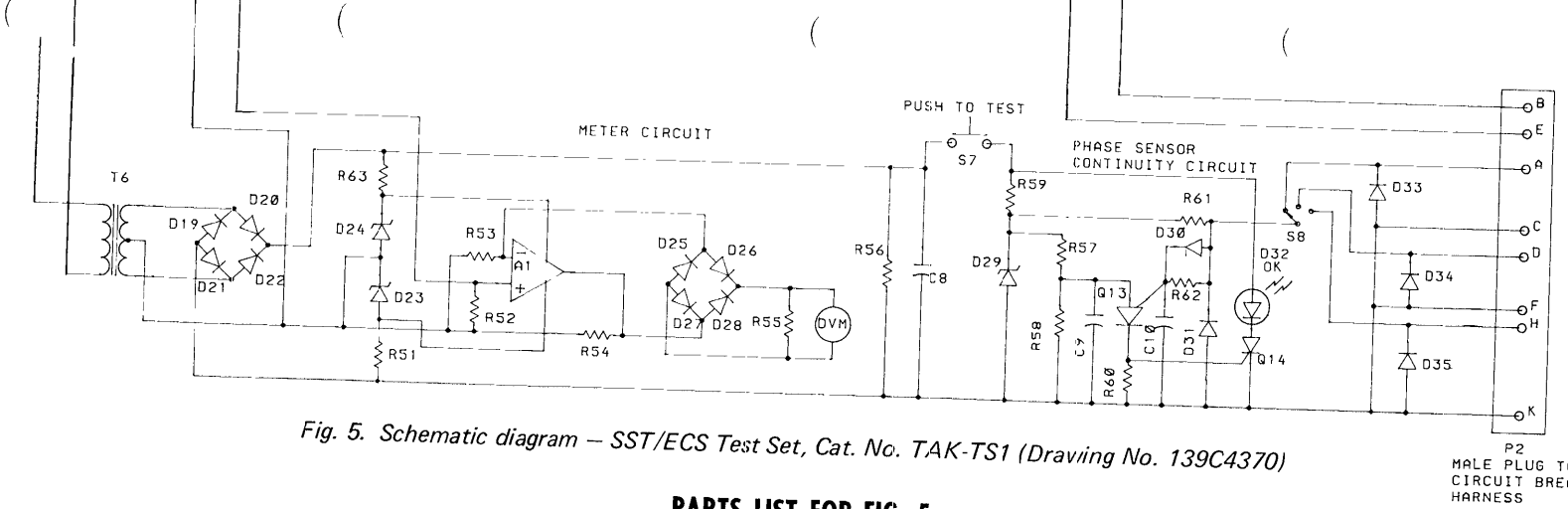


Fig. 5. Schematic diagram — SST/ECS Test Set, Cat. No. TAK-TS1 (Drawing No. 139C4370)

PARTS LIST FOR FIG. 5

RESISTORS	DESCRIPTION (Ohms)
R1	0.2 ± 0.1% - 25W
R2	0.5 ± 1% - 50W
R3	10 0 ± 1% - 25W
R4	3000 ± 5% - 10W
R5, R12, R13, R58	1K ± 1% - 1/4W
R6	909 ± 1% - 1/4W
R7	261 ± 1% - 1/4W
R8	196 ± 1% - 1/4W
R9	154 ± 1% - 1/4W
R10	121 ± 1% - 1/4W
R11	100 ± 1% - 1/4W
R14	2 8K ± 1% - 1/4W
R15	806 ± 1% - 1/2W
R16, R17, R18, R32	100K ± 1% - 1/4W
R19, R20, R44, R52, R62	1 MEG ± 10% - 1/4W
R21	332K ± 1% - 1/4W
R22	681K ± 1% - 1/4W
R23, R24, R28	51K ± 5% - 1/4W
R25	22K ± 5% - 1/4W
R26, R34, R37, R40, R48, R60	1K ± 5% - 1/4W
R27	220 ± 5% - 1/4W
R30, R39, R45	2.2K ± 5% - 1/2W
R31	34K ± 1% - 1/4W
R33	1 0 ± 1% - 3W
R35, R36, R41	2 2K ± 5% - 1/4W
R38, R46	4.7K ± 5% - 1/4W

RESISTORS (Cont'd)	DESCRIPTION (Ohms)
R42, R43	10K ± 5% - 1/4W
R47	270 ± 5% - 1/4W
R49	2 7K ± 5% - 1/2W
R51, R63	1K ± 5% - 1/2W
R53	1406 ± 0 1% - 1/8W
R54, R50	100K ± 5% - 1/4W
R55	1500 ± 0 1% - 1/8W
R56	100K ± 10% - 1/2W
R57	3 65K ± 1% - 1/4W
R59	100 ± 5% - 2W
R61	390 ± 5% - 2W
R64	560 ± 5% - 1/2W
R65	68 ± 5% - 1/2W

CAPACITORS	DESCRIPTION (Mfd.)
C1	1 0 ± 10% - 250 VDC
C2	270 ± 10% - 15 VDC (Tantalum)
C3, C4, C6, C9, C10	0.1 ± 10% - 100 VDC
C5, C8	150 - 75 VDC (Aluminum)
C7	0 33 ± 10% - 50 VDC

DIODES	DESCRIPTION
BR1	Varo VE18
D1, D2, D11, D12, D13, D14, D16, D25, D26, D27, D28, D30	IN4148

DIODES (Cont'd)	DESCRIPTION
D4, D5, D6, D7, D15, D17, D19, D20, D21, D22, D31, D33, D34, D35	IN5060
D3, D8, D10, D18, D32	LED - 28V - 20 ma
D9	15 V ± 1% - 1W
D23, D24	IN4740 - 10V - 1W
D29	IN5352B - 15V - 5W

TRANSISTORS AND SCRS	DESCRIPTION
Q1, Q3, Q4, Q9, Q11	GET 930
Q2, Q6, Q10, Q13	2N6028
Q5	2N5087
Q7, Q8, Q12, Q14	C103B
A1	OP Amp MC1741CP

TRANS-FORMERS	DESCRIPTION
T1	Variable Transformer GE 9T92A1
T2	Stancor P8641
T3	Triad N-48X

TRANS-FORMERS (Cont'd)	DESCRIPTION
T4	GE 567B743G4
T5, T6	Stancor P8601

SWITCHES	DESCRIPTION
S1	JBT ST22K
S2	Centralab SA2021-4C-000
S3	Grayhill 4002
S4	Grayhill 46-05-08-502-0101
S5, S7	Grayhill 4001
S6	JBT ST12D
S8, S9	Centralab SA2001-4C-000

RELAYS	DESCRIPTION
K1, K2	Allied T154-4C-28 VDC

CONNECTORS	DESCRIPTION
P1	Amp 201298-1
P2	Amp 201297-1

VARISTOR	V150LA20A
TIMER	Cramer 636S10084
EXTERNAL MONITOR JACK	H H Smith 269RB
DVM	Digitec 2770-02

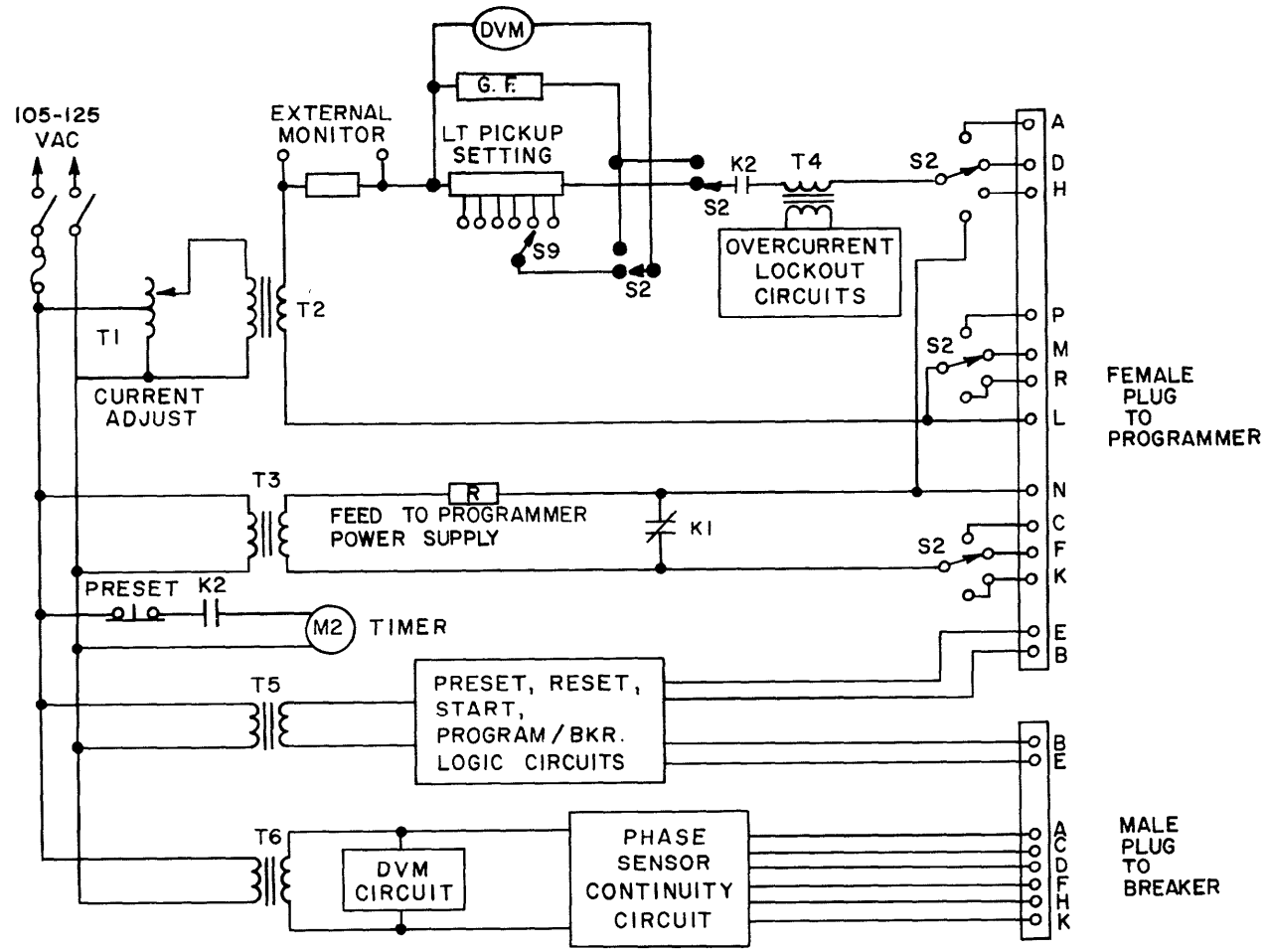


Fig. 6. Test Set simplified schematic

CIRCUIT DESCRIPTION

A brief description of the Test Set circuitry is given below. Refer to the simplified schematic of Fig. 6.

1. Input voltage is applied to the Test Set through a three-wire power cord with a ground conductor. The chassis and metal parts are grounded to protect the operator.

2. Output voltages are isolated from the input voltage by means of multiple winding iron core transformers.

3. All power to the Test Set is supplied through the ON-OFF switch and a one-ampere, slo-blo fuse.

4. T2 is a 12.6 volt filament transformer that provides the low-voltage simulated fault signal currents to the programmer via the TEST SELECTOR switch S2, when relay contact K2 is closed. The test current is adjusted by variable transformer T1.

Switches S2 and S9 provide the appropriate resistor selection for the digital meter.

The EXTERNAL MONITOR is a precision shunt resistor which provides an output that is an accurate representation of the test current.

5. The overcurrent lock-out circuit protects the programmer from prolonged or continuous testing at high current levels. Once energized, the circuit will lock out the Test Set for approximately 70 seconds and then automatically reset.

6. T3 is an isolation transformer that feeds the power supply of the programmer. Power is transferred when relay K1 is energized (normally closed contact opens). K1 is energized slightly before K2 in order to ensure that power supply voltage is available before test current is applied.

7. Power is applied to the timer by relay contact K2.

8. Transformer T5 powers the Test Set logic circuitry.

9. Transformer T6 powers the PHASE SENSOR CONTINUITY TEST circuit and the drive circuitry for the digital voltmeter.

For complete schematic diagram, see Fig. 5.

GENERAL ELECTRIC COMPANY
CIRCUIT PROTECTIVE DEVICES DEPARTMENT
PLAINVILLE, CONNECTICUT 06062

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